



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: <b>PCT/SE96/00922</b> (22) International Filing Date: <b>5 July 1996 (05.07.96)</b> (30) Priority Data: <b>9502555-7</b> <b>10 July 1995 (10.07.95)</b> <b>SE</b> (71) Applicant (for all designated States except US): <b>BTG KÄLLE INVENTING AB (SE/SE); P.O. Box 602, S-661 29 Säffle (SE).</b> (72) Inventor; and (75) Inventor/Applicant (for US only): <b>ALBRECHT, Franz [AT/AT]; Apostelgasse 15/11, A-1030 Wien (AT).</b> (74) Agents: <b>BJELKSTAM, Peter et al.; Kransell &amp; Wennborg AB, P.O. Box 27834, S-115 93 Stockholm (SE).</b>		(81) Designated States: <b>JP, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</b>  Published <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>
(54) Title: <b>DEVICE AND METHOD RELATING TO A PRESSURE-REGULATING VALVE</b> (57) Abstract <p>The invention relates to a method and a device for a valve for pressure regulation of steam, said valve including a steam plug (2) with bores (4) in its skirt (3), said bores being successively exposed as the valve is opened for achieving the regulated passage of the steam through the valve (1), and a water injection arrangement (5) situated downstream the steam plug (2) for temperature control of the steam. The water injection arrangement (5) is provided with at least one atomizing nozzle (7) for use from small openings of the valve (1), said nozzle (7) being connected to at least one feed means (9) for feeding auxiliary steam from the high pressure side (13) of the valve (1) in order to vaporize the water, said means (9) having its inlet in the area of the sealing surface (8) of the steam plug, such that the inlet will be shut off when the valve is closed. According to the inventive method, auxiliary steam is taken from the high pressure side (13) of the valve, said steam vaporizing the water used for temperature control of the steam amount regulated by means of the valve.</p>		

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Device and method relating to a pressure-regulating valve

5 The present invention relates to a device and a method  
for a valve intended for pressure and temperature  
regulation of steam, said device comprising a plug with  
a skirt provided with drilled holes, such that, as the  
plug is caused to rise, the holes are successively  
10 exposed for the regulated passage of the steam through  
the valve, and a water-injection arrangement situated  
downstream of the plug for temperature control of the  
steam.

15 Valves of the above-mentioned type commonly used on the  
market regulate steam pressure by the plug being lift-  
ed, thereby exposing drilled holes in its skirt simul-  
taneously as the valve controls the temperature of the  
steam by water being injected downstream of the plug  
with the aid of a separate system. This standard solu-  
20 tion functions at a low steam velocity in the valve  
outlet down to about 8 m/s but this has been found to  
be a great limitation, since in some cases plants have  
to work with small steam amounts giving low velocities.

25 The purpose of the present invention is to provide a  
device and a method for a valve of the kind mentioned  
above, the drawbacks existing with the above-mentioned,  
previously known arrangements being eliminated. Accord-  
ing to the invention, both pressure regulation and  
30 temperature control of the steam can be provided at low  
steam velocities. The characterizing features of the  
invention are stated in the accompanying claims.

35 Thanks to the invention, a device and a method for a  
valve of the above-mentioned type has been provided,  
which fulfil their purposes in an excellent manner,  
while the device is cheap to manufacture. By means of

the device and the method according to the invention a solution has been proposed, where the water can be vaporized with the aid of auxiliary steam taken from the high pressure side of the valve. From here the auxiliary steam is regulated by means of the steam plug in the area of its sealing surface, whereby the plug during its opening phase exposes feed means for the auxiliary steam for feeding it to at least one special atomizing nozzle, which is provided downstream of the plug and in which vaporization of the water takes place for temperature control of the low-velocity regulated steam. According to the invention, auxiliary steam can also be fed from the area of the sealing surface of the steam plug upwards through channels in the plug and further through a piping system to the atomizing nozzle or nozzles. When the valve is closed, the plug functions as a sealing means for this arrangement, since its sealing surface is then enveloped by its seal, thus closing off the distribution channels for the auxiliary steam, and when the plant is used the plug is lifted by means of an actuator for exposing the channels distributing the auxiliary steam, which can then pass to the place for injection via the atomizing nozzles on the outlet side of the valve. In accordance with the invention, this arrangement eliminates a separate, outer shut-off valve, which has otherwise been necessary.

The invention will now be described below in more detail with the aid of some embodiments and with reference to the enclosed drawings, on which

Fig. 1 shows a schematic, cross-sectional view through a first embodiment of a pressure-regulating valve in accordance with the present invention, this valve including a partly "balanced" steam plug,

Fig. 2 shows, like Fig. 1, a schematic, cross-sectional view of a second embodiment of the valve in accordance with the invention, said valve including an entirely "balanced" steam plug,

Fig. 3 shows, like Figs. 1 and 2, a schematic, cross-sectional view through a third embodiment of the valve in accordance with the invention, said valve comprising an entirely "tight" steam plug,

Fig. 4 shows a schematic side view of the device illustrated in Fig. 1 in an enlarged, partial view, and from which it will be seen how the sealing of the atomizing steam by means of the steam plug takes place,

Fig. 5 shows an enlarged, partial side view of the valve illustrated in Fig. 1 and more precisely how the atomizing steam is distributed through the steam plug and further towards the conduit feeding the steam to the atomizing nozzles, and

Fig. 6 shows an enlarged side view in section of an atomizing nozzle, in which temperature-controlling water is vaporized by means of the auxiliary steam.

As appears in more detail from Fig. 1 and from partial enlargements thereof according to Figs. 4, 5 and 6, all these views illustrate a first, preferred embodiment of the invention, which consists of a valve 1 for the pressure regulation of steam and includes a steam plug 2 with a skirt 3 provided with bores 4, which are successively exposed as the valve is opened for regulating the passage of steam through the valve 1. The valve 1 also includes a water injection arrangement 5, situated downstream of the steam plug 2 for regulating steam temperature. As appears from Fig. 1, the water injection arrangement 5 comprises both ordinary nozzles

6 for injecting water for temperature control and at least one atomizing nozzle 7 for vaporizing this water by means of auxiliary steam, said nozzles 6, 7 being fed with water via conduits 24 and at least one connecting means 25. For small openings of the valve 1, i.e. when the regulated steam has low velocity and small steam quantity and when the velocity of steam at the outlet usually may be below about 8 m/s, the mentioned auxiliary steam is fed from the high pressure side 13 of valve 1 from the sealing surface 8 of the plug 2, such that this steam can be shut off by means of the plug 2 when the valve 1 is closed. The valve is provided with at least one means 9 for feeding auxiliary steam through the steam plug to the atomizing nozzle 7. The feed means 9 thus includes an inlet 21 opening out in the sealing surface 8 of the plug 2, and the inlet being shut off when the plug is in its position corresponding to the "valve closed" state. In the atomizing nozzle 7 the water used in this case for cooling the steam is disintegrated by the auxiliary steam, very effective cooling of the regulated steam being achieved. With previously known arrangements, where this type of atomizing nozzle is not used, but only ordinary nozzles 6, erosion is caused in the system at low, regulated steam velocities by the cooling water not being disintegrated by the regulated steam, which is normally the case at high steam velocities but immerses at the outlet of the valve as water droplets, which fall against the wall of the outlet conduit and can then not be vaporized.

According to a first embodiment of the invention illustrated in Fig. 1 the feed means 9 for the auxiliary steam includes at least two distribution ducts 10 extending from outlets 21 up through the plug 2 close to its circumference, said ducts 10 being, via a chamber 15 above the plug, in communication with conduits

11 connected to the atomizing nozzle 7 at the injection place 12 on the outlet side 14 of the valve 1, on which side a silencer 22 is also arranged. As will appear in more detail from Fig. 4, for a closed valve state the sealing surface 8 of the steam plug 2 contains the mouth of the inlet 21 for the auxiliary steam conducted by the feed means 9. By this arrangement a "partly balanced" steam plug is obtained. When the valve is put into operation the plug 2 is lifted by an actuator 17, and the steam inlets 21 are exposed, thus enabling the steam to pass via the ducts 10 towards the injection place 12 at the outlet side 14 of the valve. According to this arrangement pressure is built up in the enclosed volume forming the transport path of the auxiliary steam. This means that a larger operating force is required for setting the valve than according to an arrangement, where the plug 2 is balanced.

An entirely "balanced" steam plug 2 will be seen from the embodiment illustrated in Fig. 2. Here, sealing off the auxiliary steam takes place in the same manner as with the arrangement illustrated in Fig. 1 and described above. However, distribution of the auxiliary steam takes place in a different way, so that the enclosed volume above the upper side 16 of the plug 2 can be balanced out by means of ducts 18 passing straight through the plug 2. This means that a smaller operating force is required than with the embodiment first described. Distribution of the auxiliary steam according to this embodiment takes place with the aid of a channel 20 provided centrally through the plug and its actuator spindle, and opening out above the chamber via an upper part 23 of the actuator 17. The chamber 15 is in constant communication with the downstream side 19 of the plug 2 by means of at least one elongated opening constituting said centrally situated channel 20.

The embodiment illustrated in Fig. 3 relates to an entirely "tight" steam plug 2, although sealing and distribution of the auxiliary steam take place in exactly the same manner as described above in connection with the embodiment illustrated in Fig. 2. The enclosed volume above the upper side 16 of the plug 2 is, however, not connected to any outlet to the downstream side 19, i.e. there can be no steam leakage to the downstream side.

In Fig. 6 there is shown an enlarged, cross-sectional view of an atomizing nozzle 7 used with the valve according to the invention. By using this atomizing nozzle there is obtained effective temperature control of the steam regulated by the valve 1, even for small steam velocities and small steam quantities. Just outside this nozzle the water used for steam temperature control is disintegrated by the auxiliary steam fed to the nozzle from the high pressure side of the valve. In the Figure arrows are used to show the paths of temperature-controlling water and auxiliary steam through the valve.

According to the inventive method, at pressure regulation and simultaneous temperature control of the steam through the valve, when it operates with small steam quantities and velocities, there is obtained very effective temperature control of the regulated steam. This is enabled since, for small openings of the valve, where the velocity of the regulated steam at the outlet of the valve is below about 8 m/s, the auxiliary steam is taken from the high pressure side of the valve and used for vaporization of the temperature-controlling water, the supply of auxiliary steam being regulated with the aid of the plug 2, such that feed means 9 in the area of the plug sealing surface 8 are exposed during the opening phase of the valve. The means 9 thus

allows the auxiliary steam to pass when the plug moves from its sealed position so that steam can be fed to at least one atomizing nozzle 7, for vaporization of the temperature-controlling water, thus to obtain very effective cooling of the regulated steam.

5

Claims

1. A device for a valve intended for pressure regulation of steam and including a steam plug (2) with bores (4), which are successively exposed as the plug is lifted, such as to permit the regulated passage of steam through the valve (1), and a water injection arrangement (5) situated downstream of the plug (2) for temperature control of the steam, characterized in that the water injection arrangement (5) is provided with at least one atomizing nozzle (7) for use with small openings of the valve (1), said nozzle (7) being connected to at least one feed means (9) for auxiliary steam from the high pressure side (13) of the valve (1) in order to vaporize the temperature-controlling water, said feed means (9) having its inlet in the area of the sealing surface (8) of the plug and can be shut off by means of the steam plug (2) when the valve is closed.
2. Device according to claim 1, characterized in that the sealing surface (8) of the steam plug (2) contains the inlet of the feed means (9) for the auxiliary steam.
3. Device according to claim 1 or 2, characterized in that the feed means (9) for the auxiliary steam comprises distribution ducts (10) extending through the plug (2), said ducts being in communication with conduits (11) connected to the atomizing nozzle (7) at the injection place (12) on the outlet side (14) of the valve (1).
4. Device according to any one of the preceding claims, characterized in that at least two atomizing valves (7) are arranged at the outlet side (14) of the valve (1).

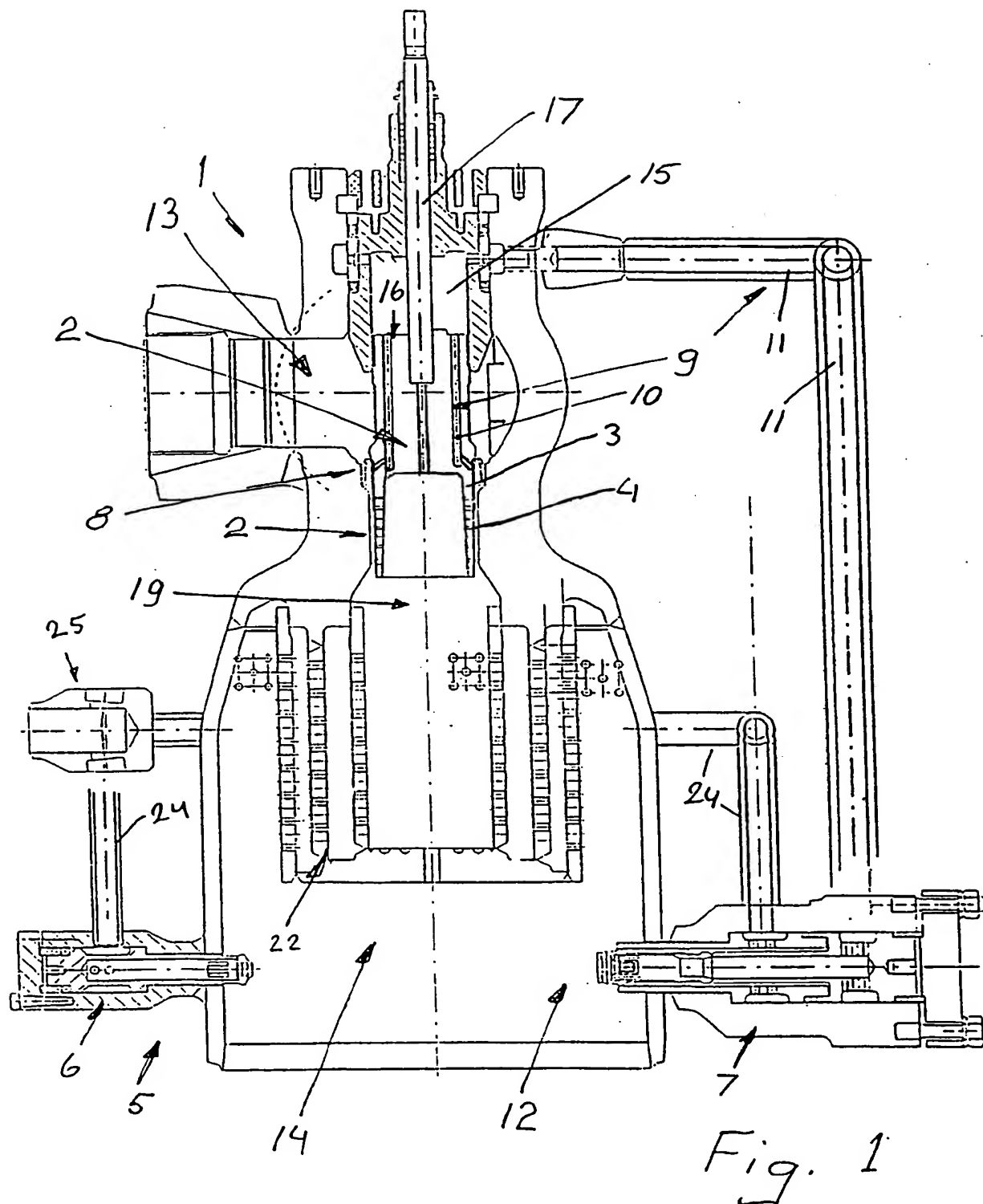
5. Device according to any one of the preceding claims, characterized in that the distribution of auxiliary steam takes place through at least two ducts (10), extending through the steam plug (2) and being arranged just inside the envelope surface of the plug (2) for communication with the conduits (11), via a chamber (15) above the upper side (16) of the plug, leading to the atomizing nozzle (7), whereby the plug (2) is partly balanced.

6. Device according to any one of the preceding claims, characterized in that the distribution of the auxiliary steam takes place through a channel (20) centrally arranged through the plug and its actuator (17), said channel communicating with the conduits (11) leading to the atomizing nozzle (7) above the space (15) on the upper side (16) of the plug (2) via an upper part of the actuator (17) and said space above the plug (2) being in constant connection with the downstream side (19) of the plug (2) by means of at least one through opening (18), whereby the steam plug (2) is entirely balanced.

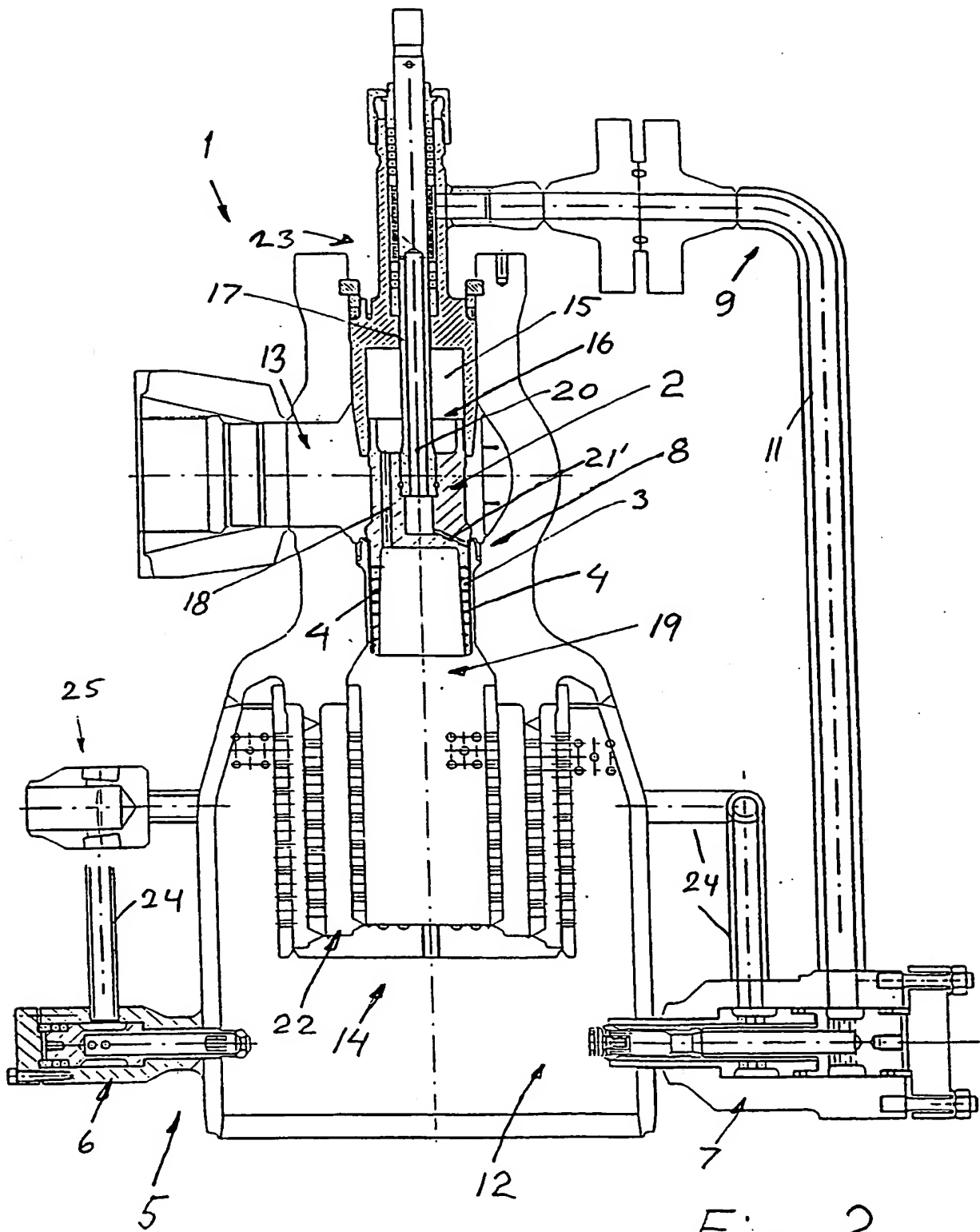
7. Device according to claim 6, characterized in that the space above the plug (2) does not have any connection to the downstream side (19) of the plug (2), whereby the steam plug (2) enables a tight valve.

8. Method for pressure regulation of steam in a valve and simultaneous temperature regulation of said steam, when the valve operates with small steam amounts and small steam velocities, said valve (1) comprising a steam plug (2) with bores (4), which are successively exposed as the valve is opened in order to regulate the steam, said temperature control taking place by water being injected downstream of the steam plug, characterized in that auxiliary steam is used for vaporiza-

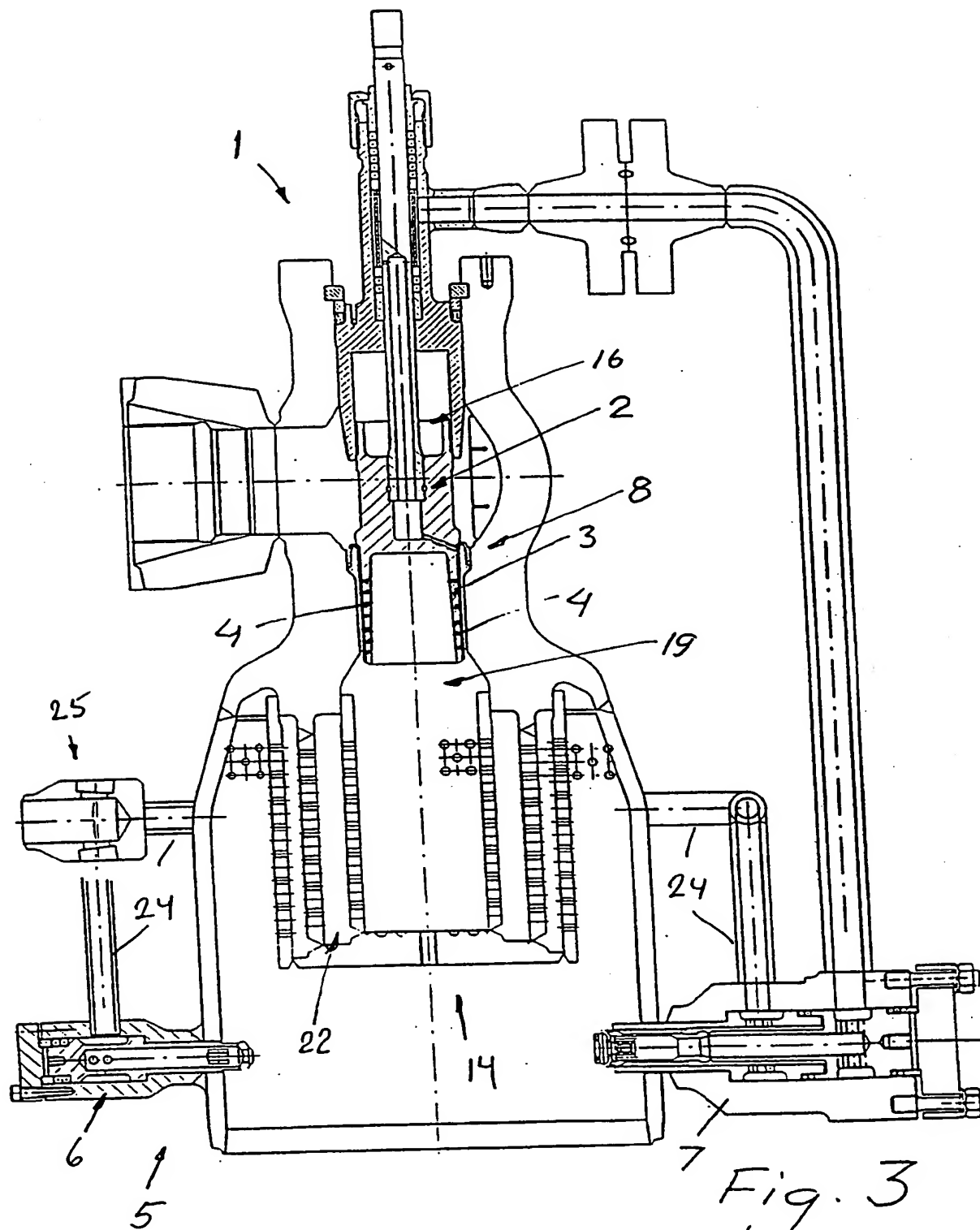
tion of the temperature-controlling water, downstream  
of the plug, said auxiliary steam being taken from the  
high pressure side (13) of the valve (1) and regulated  
with the aid of the steam plug (2) in the area of its  
5 sealing surface (8), where the plug (2) during its  
opening phase exposes at least one feed means (9) for  
the auxiliary steam, such as to enable feeding this  
steam to at least one atomizing nozzle (7), for the  
vaporization of the temperature-controlling water.



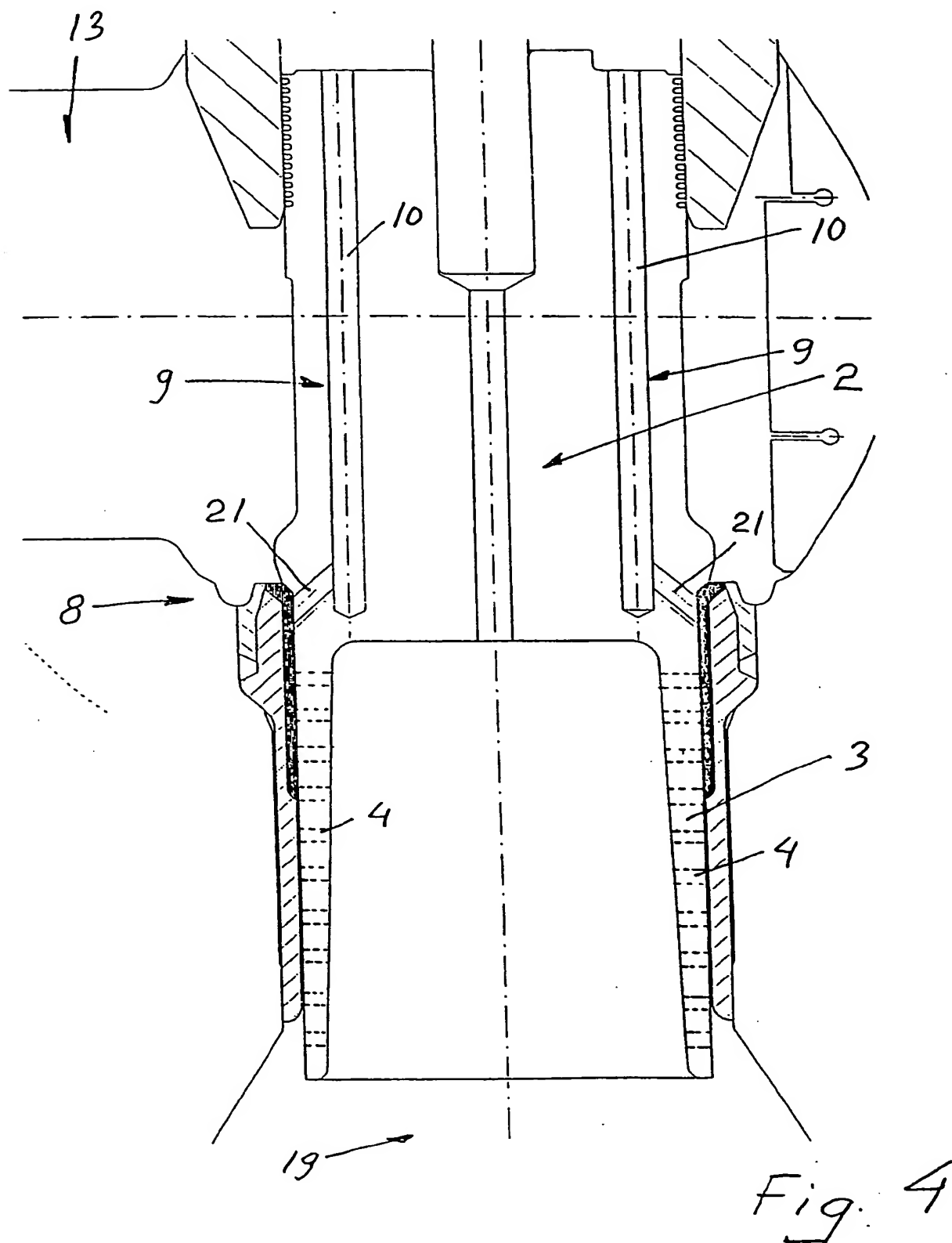
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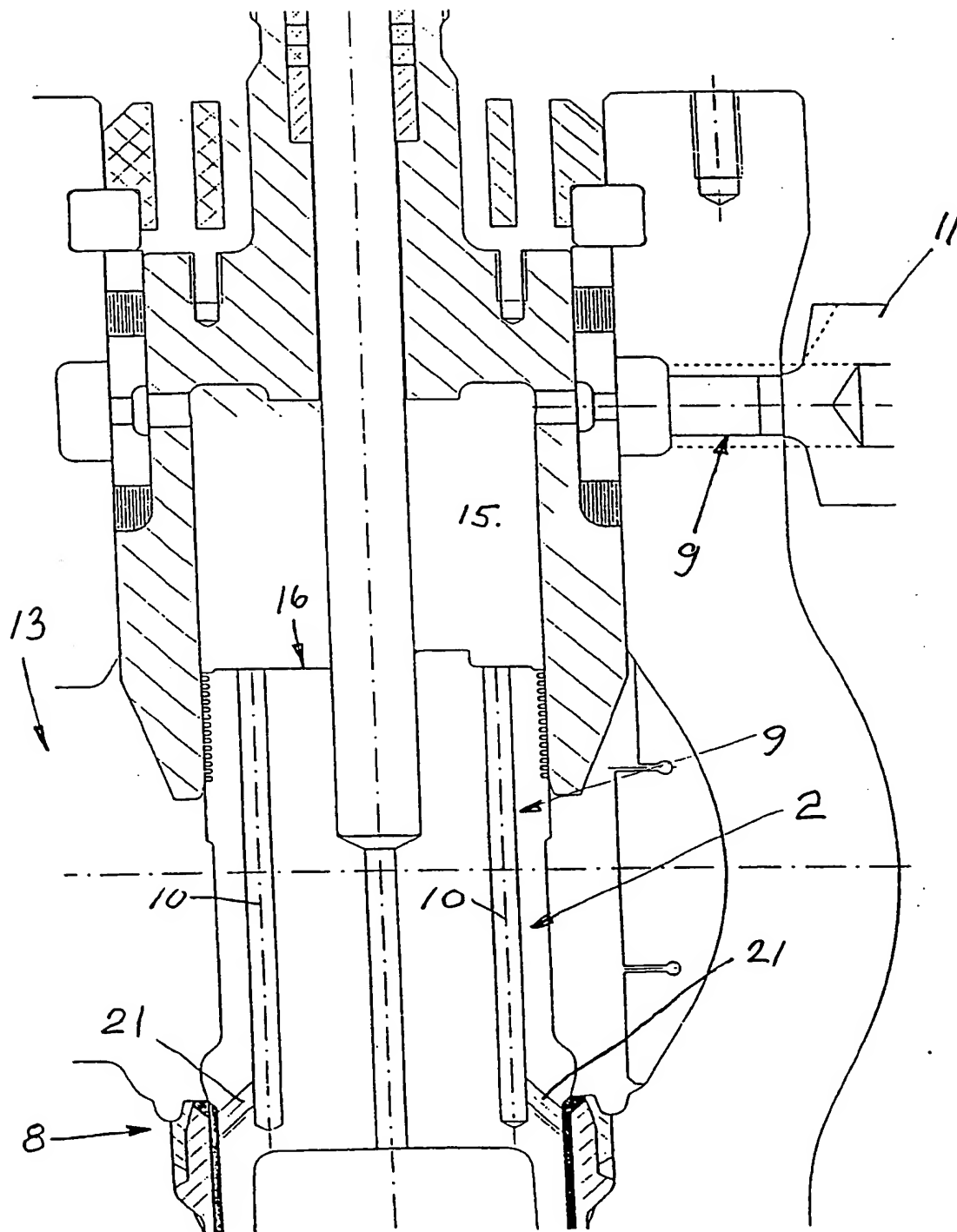
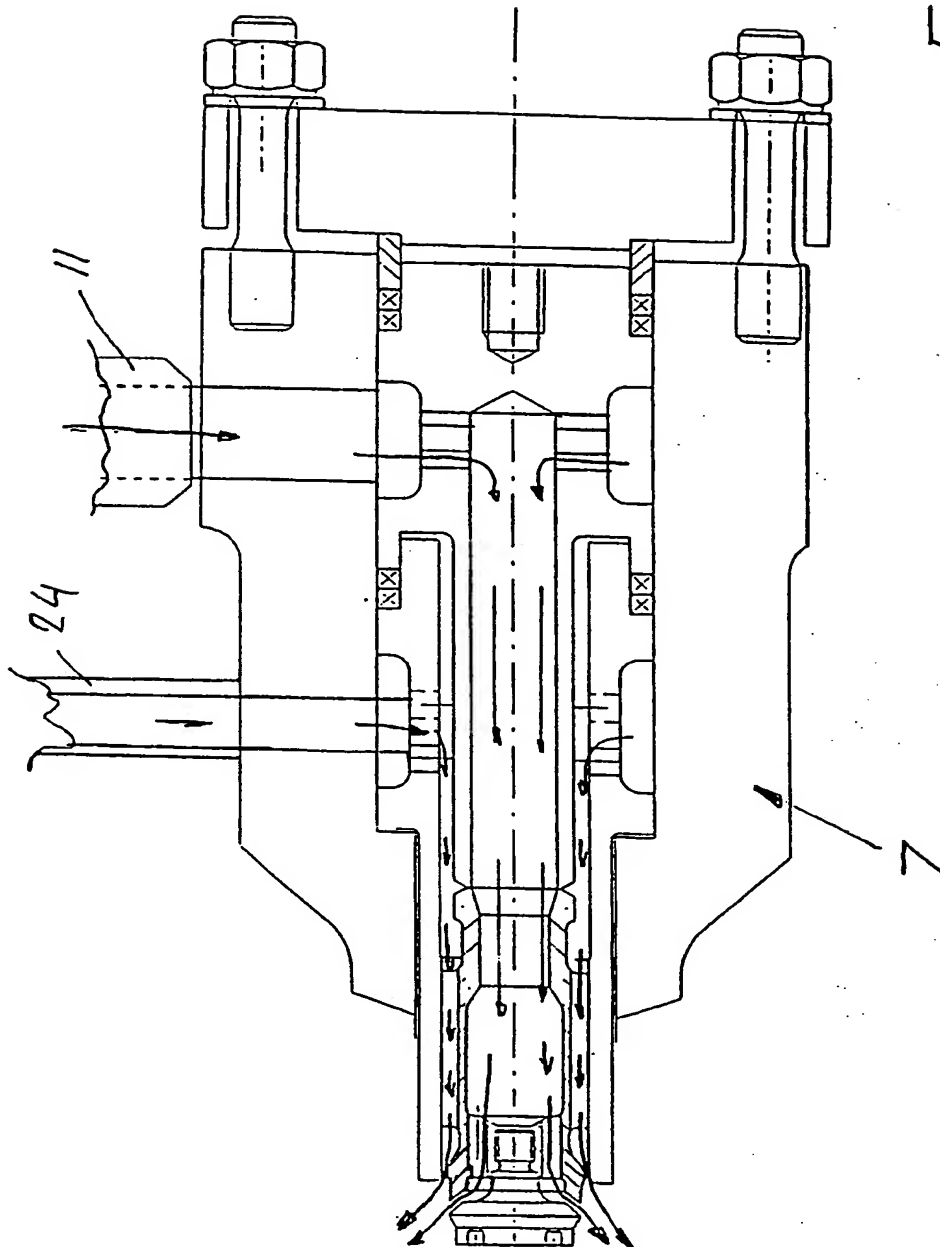


Fig. 5

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Fig 6



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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 96/00922

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F16K 47/04, F22G 5/12 // F16K 3/26

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9102915 A1 (KEYSTONE INTERNATIONAL HOLDINGS CORP.), 7 March 1991 (07.03.91), figures 1-3, claims 1-4 --	1,8
A	WO 9404255 A1 (BTG KÄLLE INVENTING AB), 3 March 1994 (03.03.94), figures 1,1A,2, claims 12, 17 -----	1,8

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

01/10/96

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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